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ABSTRACT

This reported investigation is the Phase I effort of a task which undertakes to develop a new student critique form for Air Training Command (ATC). Specifically, it deals with the identification of valid and reliable psychometric measures of student attitudes toward Air Force technical training. Two critique form prototypes were developed using a Likert-type and Guttman-type configuration. These were administered in a counterbalanced order to samples of officers, NCO, and airmen enrolled in an ATC technical school. Multiple-factor analyses and multiple discriminant function analyses were performed for the scored responses of the subjects to these critique forms. Test-retest reliability and factorial and discriminative validities were established for each of the prototypes. On the basis of the statistical analyses of the two forms, the Likert configuration was recommended for further development. Eight Likert factors, or unidimensional scales, were defined: Instructor Competence, Training Management, Specialty Training, Training Impressions, Training Facilities, Repetitious Instruction, Intelligible Media, and Textbook Utility. Because of demonstrated differences between rater groups, it was also recommended that group-specific forms be developed. (Author)

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AFHRL-TR-70-37

DEVELOPMENT OF PSYCHOMETRIC MEASURES OF STUDENT ATTITUDES TOWARD TECHNICAL TRAINING: RELIABILITY AND FACTORIAL VALIDITY

By

Pat-Anthony Federico, 1st Lt, USAF

TECHNICAL TRAINING DIVISION
Lowry Air Force Base, Colorado

November 1970

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FOREWORD

This study represents a portion of the in-house research program of Project 1121, Technical Training Development; Task 112103, Evaluating Individual Proficiency and Technical Training Programs. Dr. Marty R. Rockway was the Project Scientist and Capt Wayne S. Sellman was the Task Scientist. The report covers research performed between January 1970 and May 1970.

The author wishes to express appreciation to Lt Col Walter F. Murphy, Dr. Marty R. Rockway, Capt Wayne S. Sellman, Capt James R. Burkett, and Capt Kent H. Huff for their helpful critical comments. Special appreciation goes to 2d Lt Edward M. Gardner and Mr. Gerald S. Walker for their assistance in debugging and running statistical routines from the Laboratory's computer library.

This report has been reviewed and is approved.

George K. Patterson, Colonel, USAF
Commander

ABSTRACT

This reported investigation is the Phase I effort of a task which undertakes to develop a new student critique form for Air Training Command (ATC). Specifically, it deals with the identification of valid and reliable psychometric measures of student attitudes toward Air Force technical training. Two critique form prototypes were developed using a Likert-type and a Guttman-type configuration. These were administered in a counterbalanced order to samples of officers, NCO, and airmen enrolled in an ATC technical school. Multiple-factor analyses and multiple discriminant function analyses were performed for the scored responses of the subjects to these critique forms. Test-retest reliability and factorial and discriminative validities were established for each of the prototypes. On the basis of the statistical analyses of the two forms, the Likert configuration was recommended for further development. Eight Likert factors, or unidimensional scales, were defined: Instructor Competence, Training Management, Specialty Training, Training Impressions, Training Facilities, Repetitious Instruction, Intelligible Media, and Textbook Utility. Because of demonstrated differences between rater groups, it was also recommended that group-specific forms be developed.

SUMMARY

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Problem

The Air Force has an enormous investment the training of its technical personnel. The primary responsibility for the development of technical training programs resides with instructional systems development teams. Because of the large number of variables which may influence the performance of any instructional system, such systems must be subjected to periodic evaluation and revision to ensure their continuing effectiveness. Potentially valuable data for evaluating instructional systems consist of the attitudes of the trainees themselves. In view of these facts, ATC requested that the Air Force Human Resources Laboratory, Technical Training Division, develop and evaluate an improved student critique form. Subsequently, a three-phase research program was defined and implemented to fulfill this objective. The Phase I effort presented in this technical report concerned itself with developing two critique form prototypes and establishing their factorial and discriminative validities and test-retest reliabilities.

Approach

Two critique form prototypes were constructed using as the contents of the stimulus items student-generated criteria obtained from a previous study. The content of each of the 55 items was structured according to two different formats, a Likert-type configuration and a Guttman-type configuration. Not only were all items within one critique form of the same format, but also all were composed in such a manner to reduce as much as possible any variability among items due to phraseology. Each item was randomly placed in its sequential position among the items of each form; every item maintained the same sequential position within both experimental critique forms. These critique prototypes and their corresponding instructions were presented in a counterbalanced order within subjects to avoid any unwanted sequential effects. The subjects were 100 officers, 90 NCOs, and 99 airmen who were taking courses at Lowry Technical Training Center. Multiple-factor analyses, multiple discriminant analyses, test-retest reliabilities, and other related statistics were computed on the scored responses of the subjects to the two experimental critiques.

Results

The factorial, sampling, and discriminative validities and test-retest reliabilities were determined for each of the critique prototypes. A comparison was made between the Likert format and the Guttman format to determine which would be more suitable as a future critique form. The Likert configuration was recommended for further development on a possible replacement for the current critique form. The eight Likert factors, or unidimensional scales, were defined as follows: Instructor Competence, Training Management, Specialty Training, Training Impressions, Training Facilities, Repetitious Instruction, Intelligible Media, and Textbook Utility.

Conclusions and Recommendations

The advantages derived from the utilization of attitude scales for a new critique form were enumerated. The development of these unidimensional scales was initiated. Eight new factors of student attitudes toward technical training were identified. It was suggested that these eight factors be further developed into eight unidimensional attitude scales by having samples of trainees originate more items to guarantee greater scale reliability and discrimination. Officers, NCOs, and airmen were found to have significantly different attitudes with respect to several distinct factors of training. It was recommended that specific sets of attitude scales be established that are unique to each of these groups. It was indicated that a followup study will be performed to norm the scales for each group of trainees so that students' scores can be interpreted and compared relative to scores of their peers. Benefits derived from the applications of computers and their associated peripheral components were specified. It was advocated that this technology be utilized to implement and to manage the critique program at Air Force technical training centers.

This summary was prepared by Pat-Anthony Federico, Technical Training Division, Air Force Human Resources Laboratory.

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DEVELOPMENT OF PSYCHOMETRIC MEASURES OF STUDENT ATTITUDES TOWARD TECHNICAL TRAINING: RELIABILITY AND FACTORIAL VALIDITY

I. INTRODUCTION

The Air Force has an enormous investment in the training of its technical personnel. The purpose of various technical training programs is to instruct a sufficient number of officers, noncommissioned officers, and airmen to maintain the Air Force in a state of operational readiness. Without knowledgeable and skilled individuals, the many command missions could not be completed. The primary responsibility for the development of Air Force technical training programs resides with instructional systems development teams which include instructional system analysts, curriculum designers, and subject-matter specialists. The programs, and the training environment in which they are imbedded, are intended to produce operationally effective skills, knowledges, and attitudes in the students who are exposed to them. Because of the large number of variables which may influence the performance of any instructional system, such systems must be subjected to periodic evaluation and revision to ensure their continuing effectiveness.

Potentially valuable data for evaluating instructional systems consists of the attitudes of the trainees themselves. Methods of training which seem infallible to training supervisors may be completely boring and totally ineffective to the student. Training literature which is comprehensible to technical course authors may be meaningless to the uninitiated. Visual aids designed by graphics specialists to clarify certain concepts may actually cloud these notions for trainees. Classroom conditions which appear ideal to the instructor may actually interfere with student learning. These are only a few aspects of the instructional and physical environments which affect student learning at Air Force technical schools. Needless to say, how each trainee reacts to the many facets of the total technical training environment determines to a large extent how well he will learn his technical specialty. Consequently, the managers and supervisors of Air Force technical instruction must concern themselves with the opinions, reactions, and attitudes of every individual enrolled in technical schools not only to develop and maintain the operational capability of the Air Force, but also to ensure a cost-effective training program. In recognition of this fact, the Air Force has developed a student critique program to obtain student reactions concerning various aspects of the total technical training environment. The objective of this program, as stated in ATCR 52-29, is

> . . . to obtain from students constructive criticism of training, the training environment, and base support facilities and services. Although the student's opinions may be based upon limited background and qualifications, his attitudes and reactions affect his learning and must be considered in evaluating training. A well designed and administered critique program provides commanders and supervisors useful and necessary information for improvement of training and the student environment (para. 2, 17 July 1970).

Implied in this objective is a model that considers Air Force training as a closed-loop cybernetic system. Student criticism provides some of the feedback which is necessary for this system to attain and to maintain a satisfactory level of operation. In this model constructive criticism performs three vital functions that help determine the efficiency and the efficacy of the training program:

1. Information - it furnishes commanders and supervisors with data about the current state of the training system;
2. Reinforcement - it strengthens or weakens various notions about the nature of the training program; and
3. Motivation - it incites corrective action within the system when it is warranted.

One of the instruments that Air Training Command has at its disposal to obtain criticism from students is ATC Form 736, Student Critique. A copy of the form is shown as Appendix I. Students are encouraged, but are not required, to complete this form near the end of type 2, 3, or 4 training.[1] A trainee responds to this form by

[1]Type 2 training is ATC special training. It is formal training of a one-time nature conducted by ATC instructors at an ATC base, contractor facility, or other designated site. Type 3 training is resident regular training. It is formal training of a continuing nature conducted at an ATC installation. It includes basic, lateral, advanced, and supplemental courses. Type 4 training is field training. It is special or regular on-site training conducted by a field training detachment or mobile training teams from an ATC training center.

indicating one of three value judgments (Outstanding, Satisfactory, Unsatisfactory) for eight different aspects of training: Instruction, Individual Assistance, Training Methods, Training Literature, Training Equipment, Visual Aids, Written and Practical Tests, and Classroom and Training Area. In addition to rating these eight aspects, the student also makes an Overall Evaluation of the Course. This ninth category is provided in order to give the trainee an opportunity to evaluate the course he is taking as a whole. Data derived from student critiques are intended to be used for the evaluation, revision, and development of Air Force technical and maintenance courses. Needless to say, the utility of these data is a joint function of both the validity and the reliability of the form itself. That is, does the form measure what it purports to measure, and to what extent does it yield consistent measures?

The efficacy of the current student critique form depends upon at least two somewhat questionable assumptions: (*a*) that the three rating terms (Outstanding, Satisfactory, Unsatisfactory) have essentially the same meaning for every trainee who completes the form, and (*b*) that every trainee who completes the form uses essentially the same criteria in making his judgments. A brief study conducted by the Special Evaluation Branch, Training Evaluation Division, 3415th Technical School, Lowry Air Force Base (1967) concerned itself with the second assumption. Essentially, after approximately 150 airmen had completed ATC Form 736, they were requested to complete another improvised form. This form required them to state what criteria they had considered in rating several aspects of training either "Outstanding" or "Unsatisfactory" on ATC Form 736. These criteria were rank ordered and tabulated according to frequency of comment by the students. The results of the investigation did not support the assumption. On the contrary, it was found that practically no students who completed ATC Form 736 for the study were guided in their ratings by the approximately forty criteria stated on or implied by the form, and that most students did not use the same criteria as other students in making their judgments. Based on these findings, it was concluded that (*a*) student critique data do not reflect ratings based upon criteria suggested or implied in ATC Form 736, (*b*) students use notably different criteria in their evaluation of training than do those individuals who manage Air Force instruction, and (*c*) student critiques of training are based upon such widely variant and diffuse criteria as to be of little value in actually assessing the quality of training being provided. In other words, it was determined that ATC Form 736 has little validity; that is, it does not measure what it purports to measure. Therefore, information obtained from the student critique form by any method is of limited utility. Also, the drudgery involved in reading and summarizing hundreds of critique forms may unintentionally influence the evaluator himself who must actively endeavor to remain objective in his analysis. On the basis of this evidence, the value of ATC Form 736 for measuring student attitudes toward Air Force training appears to be highly questionable.

In view of the findings, Air Training Command requested that the Air Force Human Resources Laboratory, Technical Training Division, develop and evaluate an improved critique form. Subsequently, a three-phase program was defined and initiated to fulfill this request. The objectives of phase one of the study were four-fold: (*a*) to identify valid and reliable psychometric measures of student attitudes toward Air Force technical training by the implementation of demonstrated attitude scaling methodology, (*b*) to determine by statistical means the factor structure of student attitudes toward technical training as the first step in establishing a new critique form, (*c*) to originate a critique form that can be objectively analyzed and interpreted, and (*d*) to examine two different types of attitude scaling formats to determine the suitability of each as a potential critique form. The objective of phase two of the study will be twofold: (*a*) to have sufficiently large samples of student officers, NCOs, and airmen generate more stimulus items to guarantee greater scale reliability and discrimination, and (*b*) to norm for trainees three group-specific critique forms so that student attitudes can be interpretated relative to their peers. These forms will be proposed as replacements for the current ATC Form 736. The objective of the third phase will be to originate appropriate computer software to manage the entire critique program within Air Force technical training centers by administering, scoring, and interpretating student critique forms.

In measurement of student reactions toward Air Force technical training, certain advantages are derived from using an attitude item with multicategory response alternatives which are assumed to measure one underlying psychological continuum. These advantages are suggested as alternatives to the aforementioned disadvantages

derived from incorporating within ATC Form 736 a stimulus item with tri-category response alternatives, which were determined to have many ambiguously related underlying psychological continua. By using an adequate quantity of response alternatives, a satisfactory degree of validity, reliability, and discrimination can be readily attained. Items having a sufficient number of response alternatives, unlike those items composing the present ATC Form 736, yield the kind of data upon which factor analysis can be run to establish unidimensionality. That is, items can be identified which form an independent or orthogonal attitude scale by measuring a single dimension of training. Validity is more meaningful when a single dimension or factor is involved since it can be more readily determined what the scale items are measuring in common. Consequently, the whole worrisome problem of the ambiguous critieria inherent in the use of ATC Form 736 virtually vanishes when this approach to the measurement of student attitudes is adopted. A single dimension ensures that student reactions to training will fall on the same independent continua and not those nebulously dependent continua currently implied by ATC Form 736. Therefore, students can be more reliably ranked with respect to the various dimensions or factors of Air Force technical training. Also, the more response alternatives a stimulus item has, the more finely and surely it can discriminate among individuals of different attitude constellations.

There are additional advantages to measuring student opinions by valid, reliable, and unidimensional attitude scales. By their use there is less likelihood of being misled by gross percentages; a more sensitive and accurate instrument is provided for classifying student responses into categories; student behavior can be predicted more easily; variation of student opinion on a given factor can be analyzed by using graduated scale scores; reactions of various classes, schools, and entire training programs can be more readily compared; scaled attitude scores can be used to statistically determine the relationships of student attitudes with other aspects of their training; student attitude scores can be easily scored and objectively analyzed; change of student attitudes over time can be readily measured; and the entire critique program at a training center can be effectively managed by utilizing quantitative scaled scores and computer technology. Making use of the computer to perform these functions will free training commanders and supervisors from the perusal of hundreds of critique forms. The implementation of attitude scales, source data automation techniques (that is, optical mark reading, optical character recognition, machine readable forms, and Porta-Punch cards) and computer technology will make possible more frequent sampling of student attitudes than just at the end of their technical training. This will yield more reliable measures of student opinions; furthermore, this will give training commanders sufficient lead-time to improve those conditions of the training situation toward which the students are critical. Consequently, actions can be taken that will significantly improve training and student morale. Both of these improvements can enhance the quality of training and reduce the rate of student attrition. Theoretically, at least, student morale will be higher because they will have a feeling of participation in how the training program is executed. This is just one of many examples which demonstrates the operation of a closed-loop cybernetic training system where student feedback or criticism serves many vital functions.

II. METHOD

Subjects

The subjects were 100 officers, 90 NCOs, and 99 airmen who were taking courses at Lowry Technical Training Center. Entire classes were randomly selected from five technical school departments: Intelligence, Avionics, Logistics, Munitions, and Photography. All subjects had been enrolled in their respective technical schools for one month or more. This was assumed to be long enough for them to have crystallized some attitudes toward Air Force technical training.

Construction of an Experimental Critique Form

The contents of the stimulus items used in this investigation were obtained from the student-generated criteria tabulated in the aforementioned report by the Training Evaluation Division at Lowry. Criteria that were mentioned by the trainees five or more times were chosen for stimulus items. These 51 selected criteria became the contents of 51 corresponding items that served as the basis for two distinct sets of stimulus items which were considered to be developmental models of a proposed critique form. These 51 items were combined with four more items that were generated by the author. These four items

were included in these critique-form prototypes to provide additional information concerning student attitudes toward Air Force technical and maintenance training. It was thought that the information furnished by these four items would provide greater insight into the reactions of technical trainees. The items dealt with global attitudes regarding the Establishment, the Military, the Air Force, and the War. Only the contents of these four items were generated by the author. To maintain a high degree of sampling validity, the contents of the stimulus items were largely generated by random samples of students, not training supervisors.

The content of each of the 55 items was structured according to two different formats. One of the formats imposed upon the items was a Likert-type configuration (Likert, 1932; Edwards, 1957); the other format imposed upon the items was a Guttman-type configuration (Guttman, 1944, 1950; Edwards, 1957). These two sets of 55 structurally distinct items were used to construct two different, but related, critique forms. The forms were related in the sense that for each item written in the Likert format there was a corresponding item written in the Guttman format which had essentially the same content. The following items from the two forms are examples of the same content structured in Likert and Guttman formats.

Likert structure:

Most of the time your instructor assists you individually by clearly explaining difficult technical material.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

Guttman structure:

What percentage of the time does your instructor assist you individually by explaining difficult technical material?

( ) 0% of the time.
( ) 25% of the time.
( ) 50% of the time.
( ) 75% of the time.
( ) 100% of the time.

Not only were all items within one critique form of the same format, but also all were composed in such a manner to reduce as much as possible variability among items due to phraseology. The experimental critique forms and their instructions are shown as Appendix II and Appendix III. Each item was randomly placed in its sequential position among the 55 items of each form, except the four author-generated items which occupied the final four positions of each critique form. Every item maintained the same sequential position within both critique forms. Likert items called for checking one of five responses (Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree). These five response categories were scored 5, 4, 3, 2, and 1, respectively, for items favorable to Air Force technical training. An example of a favorable item in the Likert-type scale (Appendix II) is item 1: "Most of the time you have a sufficient amount of time during technical school class days for individual study." In the typical Likert fashion, the scoring of these responses was reversed for items unfavorable to Air Force technical training. An example of an unfavorable item is item 2: "Most of the time technical school classrooms are too small for the number of students in a class." The procedure of scoring by assigning arbitrary weights to response categories correlates highly with normal deviate weighting of response categories. Also, using this procedure produces no noticeable differences in reliabilities (Likert, 1932). A subject's total score was determined by summing his responses to all the items. In order to avoid any position bias in responding to the forms, the "agreeable" end of the response continuum was alternated randomly from the left to the right among the items.

Guttman items called for checking one of five alternatives on a percentage continuum (100%, 75%, 50%, 25%, and 0%). This continuum was additionally defined by having each item specify a response dimension. For example, some items asked for percentage estimates of "hours," while others asked for percentage estimates of "lectures." The above five response alternatives were scored 5, 4, 3, 2, and 1, respectively, for items favorable to Air Force technical training. Another example of a favorable item in the Guttman-type scale (Appendix III) is item 5: "What percentage of your formal education did the Air Force consider in assigning you to a particular technical school?" As in most multi-category Guttman scales (Edwards, 1957), the scoring of these response alternatives was reversed for items unfavorable to Air Force technical training. An example of an unfavorable item is item 6: "What percentage of your instructor's presentations repeat what you were assigned to read?" A subject's total score was again determined by summing his responses to all items. Also, in order to avoid any position bias, the "100%" end of the

response continuum alternated randomly from the top position to the bottom position among the items.

Procedure

Both critique forms were presented to the subjects in booklet form. On the cover sheet of this booklet appeared generalized information descriptive of the subject's task. The following page contained a questionnaire which concerned itself with some aspects of the subject's personal history. Next in the presentation sequence were the critique forms, each preceded by its specific instructions. The two critique forms were presented in a counterbalanced order within subjects to avoid any unwanted sequential effects. Finally, following the critique forms was an open-ended questionnaire designed to give the subjects an opportunity to comment on various aspects of the attitude scales and the experimental situation.

The booklets were distributed to the students in their technical school classrooms; typical class size was approximately 12 students. Subjects were told that the booklets were self-explanatory since they contained all the necessary instructions. (These instructions were found to be easily interpretable in a previous pilot study which employed as subjects 12 airmen, 8 NCOs, and 6 officers who were presented with experimental booklets. These 26 subjects were asked to read the instructions and items and to make any comment regarding the intelligibility of the instructions and the items.) While the subjects were responding to both critique models and the questionnaires, they were supervised by an assistant to prevent inter-subject collaboration and contamination. The technical instructor for each class was present during the 45 minutes in which the subjects responded to these forms. In this time interval, each instructor responded to a special questionnaire. The instructor questionnaires were designed to gather data regarding their reactions to the proposed critique prototypes. The test-retest reliability procedure involved an additional 35 students (14 airmen, 12 NCOs, and 9 officers) who were given booklets containing both experimental critique forms and their respective instructions. This sample of students responded to the forms at that time; and they again responded to the same critiques one week later. This one-week interval between testings was considered to be sufficient since subject retention over the period was expected to be quite low.

III. RESULTS AND DISCUSSION

Two factor analyses were computed on the scored responses to the two experimental critique forms. The direct solution employed was the method of principal components followed by a Varimax rotation, that is, multiple-factor analysis (Harman, 1967). See Appendix IV for the logic used to justify this particular method of factor analysis and the approximation of communalties by squared multiple correlation coefficients. These factor analyses were computed in order to account for a major portion of the variance in the response of the subjects to the 55 items of each critique form in terms of a smaller number of derived variables or independent factors. The results of the multiple-factor analysis of the Likert data are presented and discussed, followed by results of the multiple-factor analysis of the Guttman data.

The Likert principal-component analysis and its associated statistics are tabulated in Tables 2 through 6 in Appendix V. The first eight factors in the principal factor pattern of the Likert items appearing in Table 4 were rotated using the Varimax criterion for simple structure (Kaiser, 1958). Only the first eight factors were rotated since approximately 94 percent of all significant factor loadings appeared within these eight factors. This Varimax factor pattern is found in Table 6. These eight orthogonal Likert factors, or unidimensional scales, were defined as follows: Instructor Competence, Training Management, Speciality Training, Training Impressions, Training Facilities, Repetitious Instruction, Intelligible Media, and Textbook Utility. Each factor was identified in the following fashion. Items which loaded a particular factor were determined by inspection of Table 6. The common content of this set of items was derived by perusal of every item in the set. This content area was interpreted and labeled to appropriately convey the meaning that was attached to the factor. Obviously, there could be at least as many interpretations of each factor as there are people who are willing to follow this precedure. Note that these eight newly established factors differ somewhat from those eight aspects of training which appear on ATC Form 736. This was anticipated since the Likert critique form was constructed from different items than the present critique form. One of the implications of this difference for the development of a new critique form would be to base this proposed form upon the eight newly derived factors or scales. Not only are these factors orthogonal and

unidimensional but also 93 percent of the items were generated by trainees themselves. Consequently, these statistically determined unidimensional scales are representative of a sample of Air Force technical students, unlike ATC Form 736 which had its eight aspects of training and their respective criteria generated by managers of Air Force technical training.

The Guttman principal-component analysis and its related statistics are reported in Tables 7 through 11 in Appendix VI. The Varimax factor pattern of the Guttman items is found in Table 11. Using the same procedure as described for the Likert items, these eight orthogonal factors were identified as follows: Instructor Competence, Training Impressions, Training Comprehensibility, Speciality Training, Repetitious Instruction, Intelligible Media, Training Facilities, and Squadron Nurturance. This rotation produced two new factors which did not appear in the rotation of the Likert principal components: Training Comprehensibility and Squadron Nurturance. For further clarification of the meaning of these factors, see the experimental Guttman critique form (Appendix III) and read the items which load each factor of interest (Table 11 of Appendix VI). A comparison of these Guttman factors (labeled with prime values) and the Likert factors, in terms of the number of items with significant loadings in common for each of the factor pairs, appears in Table 1. Note too, that the Guttman factors are different from the eight aspects of training mentioned on the present critique form. The same comments can be made about the sampling characteristics of these unidimensional scales as were made previously concerning the sampling characteristics of the Likert unidimensional scales.

Three multivariate discriminant analyses (DSCRIM) were computed on the data (Veldman, 1967). Two of these analyses were performed to see how well each of the critique prototypes distinguished among officers, NCOs, and airmen. The other analysis was conducted to see if subjects had responded significantly differently to the corresponding items of both critique forms because of the structural differences between them. DSCRIM among group responses to the Likert items and other associated statistics are presented in Tables 12 through 16 in Appendix VII. The data suggested that NCOs have more favorable attitudes than airmen toward 13 of the items. These items happened to have been the essential elements which constituted Likert Factor IV, Training Impressions. The implication was that NCOs have more favorable impressions of Air Force technical training than do airmen. Similarly, the statistics indicated that officers have less favorable attitudes than do NCOs regarding several aspects of Factor II, Training Management, and Factor III, Speciality Training. Also, the same statistics implied that officers possess more positive attitudes than do airmen concerning certain aspects of Factor II, Training Management, and Factor IV, Training Impressions. Consequently, it was inferred that several Likert factors discriminated well enough to distinguish the different attitudes of officers, NCOs, and airmen toward some dimensions of Air Force technical training. DSCRIM among group responses to the Guttman items and other pertinent statistics are tabulated in Tables 17 through 21 in Appendix VIII. These Guttman statistics essentially confirmed what was found previously in the DSCRIM analysis for the Likert items regarding the different attitudes of officers, NCOs, and airmen.

Table 1. **Factors Resulting from the Varimax Rotation of Likert- and Guttman-Type Critique Prototypes**

Likert Factors	Number of Items in Common	Guttman Factors
1. Instructor Competence (15)	12	1.′ Instructor Competence (15)
2. Training Management (13)	5	2.′ Training Impressions (10)
3. Speciality Training (9)	2	3.′ Training Comprehensibility (8)
4. Training Impressions (9)	2	4.′ Speciality Training (11)
5. Training Facilities (4)	0	5.′ Repetitious Instruction (2)
6. Repetitious Instruction (2)	0	6.′ Intelligible Media (4)
7. Intelligible Media (4)	0	7.′ Training Facilities (6)
8. Textbook Utility (6)	1	8.′ Squadron Nurturance (3)

Note. — Numbers following factor names indicate the quantity of items with significantly large loadings (.2685) on the factors.

DSCRIM between the structurally distinct experimental critique forms and its accompanying statistics are reported in Tables 22 through 25 in Appendix IX. These statistics suggested that the subjects responded significantly differently to 34 of the 55 items. It was thought that this occurred primarily because of the structural differences between the two critique prototypes. After all, corresponding items did have essentially the same content. On 27 of the 34 items, the subjects responded significantly more favorably toward some aspects of Air Force technical training on the Guttman-structured items than on the Likert-structured items. Probably, this was due to the fact that the Guttman-response continuum was unipolar unlike the bipolar Likert-response continuum. This could have caused the subjects to adopt anchor points on the response continuum for the items which were actually greater than 0 percent. Consequently, their responses to the Guttman-type items tended to be inflationary. One should be aware of this asymmetrical aspect of unipolar attitude continua when attempting to ascertain student attitudes toward Air Force technical training, since student reactions may appear more positive than they really are. One of the implications of this finding for the construction of a new critique form is the recommendation that the Likert structure be adopted as the format for the new form. In the series of followup studies for further development of a new critique form, it is proposed that investigators disregard Guttman-type formats.

Finally, the reliabilities and validities of the two experimental critique forms were established in the following manners. Test-retest reliabilities were .7393 and .6336 for the Likert form and the Guttman form, respectively. Utilizing Fisher's z technique for calculating the significance of the difference between two correlations, it was found that the reliabilities did not differ significantly (z = .8280; N = 35). Both critique prototypes have equally moderate coefficients of stability. As for the validities of these forms, firstly, factor loadings were regarded as factorial validities for each of the developmental critique forms. These factor loadings provided an indication of the extent to which both models of a proposed critique form measured various content areas. That is, these loadings were considered to be indices of the content validity of the critique forms. Inspection of the reported Varimax factor loadings (Table 6 of Appendix V and Table 11 of Appendix VI) revealed that both developmental forms comprised approximately equally orthogonal content areas. It should be emphasized here that the Varimax rotation for the Guttman-type items produced two new independent content areas which were not apparent in the Likert Varimax rotation: Training Comprehensibility and Squadron Nurturance. Secondly, the discriminative validity of these critique prototypes can be ascertained by noting how well they differentiated between officers, NCOs, and airmen as demonstrated in the multivariate discriminant analyses (Table 2 of Appendix V and Table 7 of Appendix VI). It was anticipated that these groups differed in some of their attitudes about certain aspects of Air Force technical training. For example, the discriminative validity of the Likert form was corroborated by DSCRIM and by some of the results of the univariate F tests: implications were (*a*) that NCOs have more favorable impressions of technical training than do airmen, and (*b*) that officers have more positive attitudes concerning training management and impressions than do airmen. These were just two of many instances which confirmed the sharpness of the form's discrimination. Thirdly, ATCR 52-29 states that the objective of the student critique program is "to obtain from students constructive criticism of training, the training environment, and base support facilities and services." These experimental critique forms adequately sampled each of these objectives. Investigations of the unidimensional scales which comprise these novel critique forms make this rather obvious. That is, these incorporated attitude scales have sampling validity with reference to the specified objectives of ATCR 52-29. Not only were these objectives sampled by these developmental attitudes scales, but also the content of the items themselves were obtained from students enrolled in several departments of an Air Force technical school. Consequently, another intention of ATCR 52-29 was incorporated in the critique models, namely, consideration of student opinions and reactions in the actual construction of these prototypes. The items adopted for inclusion into the experimental forms were generated by the students themselves, and not by training managers or instructors. In ATC Form 736, the aspects of training listed and the criteria mentioned were derived from training supervisors. These administrators have different perceptions of the training situation than students do. Therefore, the two critique form prototypes have more sampling validity with respect to student opinions and reactions than is implicit in ATC Form 736.

IV. CONCLUSIONS AND RECOMMENDATIONS

The analyses established several factors or unidimensional scales of Air Force technical training which differ from those aspects of training currently listed on ATC Form 736. These independent dimensions of training were determined statistically and objectively. Most of the advantages of unidimensional attitude scales can be realized by adopting as standardized critique forms further refined versions of the Likert prototype. Because of the current format of ATC Form 736, the relationships that exist among the various parameters which determine the total training environment cannot be easily and statistically specified. This is so since the data obtained by this form do not readily lend themselves to quantification. Consequently, information is not collected which could otherwise be used to manage Air Force technical training more effectively and efficiently. Recommending the further development of a Likert-type form for a new critique, besides its conservativeness relative to a Guttman-type form, is its validity and reliability. The discriminative, factorial, and sampling validities of the Likert prototype have been determined to be sufficient to permit its further development for a new critique form. DSCRIM established the discriminative validity of the scale; that is, officers, NCOs, and airmen were distinguished with respect to some of their different attitudes regarding Air Force technical training. The implication of this finding is that three distinctly different critique forms are needed to ascertain student feedback. It is proposed that a unique critique form be established for each group of trainees: officers, NCOs, and airmen. Each of these three intended forms will have to be normed for its respective group so that students' attitude scores can be interpreted and compared with respect to attitude scores of their peers.

The multiple-factor analysis demonstrated the factorial validity of the Likert form by identifying eight unidimensional attitude scales or eight independent content areas of technical training. This suggested that the new critique form be composed of eight distinct attitude scales each of which will measure one of the derived dimensions of Air Force technical training: Instructor Competence, Training Management, Speciality Training, Training Impressions, Training Facilities, Repetitious Instruction, Intelligible Media, and Textbook Utility. This will require the generation of more items for some of these eight content areas, or unidimensional scales, in order to increase their scale reliabilities. Note that the larger the sample of items per attitude scale, the more precisely it can estimate and discriminate student attitudes in regard to a particular content area or a single dimension; and the smaller the error of measurement is likely to be on any particular testing. As a larger sample of items is presented for each unidimensional scale, the more reliable it becomes. Correspondingly, the more frequently the scales are administered to technical trainees or the more students that complete the scales, the more reliable the gauging of attitudes. Therefore, not only are more items needed for some of the scales, but also all students, without exception, enrolled in Air Force technical schools should be required to complete critiques more frequently than just at the end of their training.

In order to maintain the sampling validity of the eight unidimensional Likert scales, the other items to be generated to increase the reliabilities of the scales must come from three different samples of trainees: officers, NCOs, and airmen. An appropriate sample from each group will originate items for a unique set of scales to be incorporated in its own group-specific critique form. After these additional items have been determined, they will be administered to sufficiently large samples from their respective groups so that these trainees can respond to the items. All items will then be factor analyzed again to guarantee the unidimensionality of the scales. Subsequently, it will be appropriate to norm all scales for each group of trainees.

Following the development of the scales, the next stage in the formulation of an improved critique program will entail the origination of appropriate computer software. This software will be designed to manage the entire critique system within Air Force technical training centers (*a*) by determining how frequently critiques should be administered for courses of different durations; (*b*) by scoring each scale of the proposed critique form for each student to which the form was administered; (*c*) by interpreting summarily the scale scores for training commanders, supervisors, and instructors; and (*d*) by making recommendations for improving training based upon measured student opinion. The drudgery and subjectivity involved in attempting to make the current critique program function can be replaced by readily accessible computer hardware and by effectively written computer software. Consequently, student feedback, an integral component of an efficiently operating training system, can be more easily obtained, summarized, interpreted, and utilized for improving Air Force technical instruction.

V. SUMMARY

1. The advantages derived from the utilization of attitude scales for a new student critique form were enumerated. It was proposed that unidimensional scales be constructed for this purpose. A pilot study was conducted to initiate the development of these unidimensional attitude scales and to determine how these scales should be further refined for a new critique form.

2. New factors of student attitudes toward Air Force technical training were identified and their validities were demonstrated. It was suggested that these eight factors be further developed into eight unidimensional attitude scales to be incorporated in a new critique form by having samples of trainees originate more items to guarantee greater scale reliability and discrimination.

3. Officers, NCOs, and airmen were found to have significantly different attitudes with respect to several distinct factors of training. Consequently, it was recommended that specific sets of attitude scales be established that are unique to each of these groups.

4. It was indicated that a followup study will be performed to norm for each group of trainees the developed scales so that students' scores can be compared and interpreted relative to attitude scores of their peers.

5. Benefits derived from the applications of computers and their associated peripheral components were specified. It was advocated that this technology be utilized to implement and to manage the critique program at Air Force technical training centers.

REFERENCES

ATC Regulation 52-29. *Student critique program.* Randolph Air Force Base, Texas: Department of the Air Force, 17 July 1970.

Dwyer, P.S. The contribution of an orthogonal multiple factor solution to multiple correlation. *Psychometrika,* 1939, **4**, 163-171.

Edwards, A. *Techniques of attitude scale construction.* New York: Appleton-Century-Crofts, Inc., 1957.

Guttman, L. A basis for scaling qualitative data. *American Sociological Review,* 1944, **9**, 139-150.

Guttman, L. The basis for scalogram analysis. In S. A. Stouffer et al., *Measurement and prediction.* Princeton, NJ: Princeton University Press, 1950, 60-90.

Guttman, L. "Best possible" systematic estimates of communalities. *Psychometrika,* 1956, **21**, 273-285.

Harman, H.H. *Modern factor analysis.* (2nd ed.) Chicago: The University of Chicago Press, 1967.

Kaiser, H.F. The Varimax criterion for analytic rotation in factor analysis. *Psychometrika,* 1958, **23**, 187-200.

Likert, R. A technique for the measurement of attitudes. *Archives of Psychology,* 1932, **22**, (140), 1-55.

Special Evaluation Branch, Training Evaluation Division, 3415th Technical School, *Evaluation of criteria used by students in completing ATC form 736, "Student Critique,"* Lowry AFB, Colorado, 1967.

Veldman, D. *Fortran programming for the behavioral sciences.* New York: Holt, Rinehart, and Winston, 1967.

Wrigley, C. The distinction between common and specific variance in factor theory. *British Journal of Mathematical and Statistical Psychology,* 1957, **10**, 81-98.

APPENDIX I. ATC FORM 736, STUDENT CRITIQUE

STUDENT CRITIQUE	COURSE NR	COURSE TITLE	PERIOD OF TRAINING FROM	TO

STUDENT'S NAME *(Optional)*	GRADE	DATE	CLASS NR	SHIFT	SQUADRON

INSTRUCTIONS: Below are a series of items which can be rated Outstanding (O), Satisfactory (S),or, Unsatisfactory (U). Check (✓) the rating for each item which best expresses your opinion. If you rate an item unsatisfactory (U), give specific comments and recommendations for improvement.

ITEMS	COMMENTS	RATING O	S	U
1. INSTRUCTION: (Class Control, Attitude, Enthusiasm, Helpfulness, Understandable)				
2. INDIVIDUAL ASSISTANCE: (Remedial Instruction, Counseling)				
3. TRAINING METHODS: (Amount of Theory & Practical. Use of training time, Student Participation)				
4. TRAINING LITERATURE: (Availability, Use and Helpfulness, Student Study Guides, Workbooks, Technical Orders, Manuals, Textbooks)				
5. VISUAL AIDS: (Availability, Use and Helpfulness, Films, Transparencies, Charts)				
6. TRAINING EQUIPMENT: (Availability, Use and Helpfulness, Systems Equipment, Test Equipment, Tools)				
7. WRITTEN AND PRACTICAL TESTS: (Understandable, Administration, Critique)				
8. CLASSROOM AND TRAINING AREA: (Light, Heat, Ventilation, Work Benches, Tables, Chairs, Seating Arrangement, Noise Level)				
9. OVERALL EVALUATION OF COURSE				

ADDITIONAL COMMENTS *(Use plain paper if more space is required)*

ATC FORM JUL. 66 736

APPENDIX II. LIKERT INSTRUCTIONS AND ITEMS

Please read each of the following items and indicate the amount of your agreement or disagreement with its contents. Point out the extent to which you are of the same opinion or the extent you are of a different opinion by making a check mark (√) under the appropriate item.

EXAMPLE: Most of the time Beetle Bailey enjoys basic military training.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

If you strongly disagree with this statement, you should place a check mark (√) under strongly disagree to show that you are of a very different opinion. If you agree with this statement, you should place a check mark (√) under agree to show that you are of the same opinion. If you have no opinion about the statement or if you are undecided about its contents, you should place a check mark (√) under undecided.

1. Most of the time you have a sufficient amount of time during technical school class days for individual study.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

2. Most of the time technical school classrooms are too small for the number of students in a class.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

3. Most of the time in technical school six hours of class each working day is tiresome.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

4. Most of the time in technical school the training is so regimented that the learning environment is diminished.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

5. Most of your formal education was considered by the Air Force in assigning you to a particular technical school.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

6. Most of you technical instructors' presentations repeat what you were assigned to read.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

7. Most of the time your student squadron sets aside each class night a sufficient amount of time for sleep.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

8. Most of your instructors appear not to know their subject matter.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

9. Most of your training literature is comprehensible.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

10. Most of your technical instructors appear to be well educated.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

11. Most of your training literature actually teaches you how to perform your new USAF job speciality.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

12. Most of your technical instructor's classroom presentations are well organized.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

13. Most of the time the noise level in your barracks is low enough to permit you to study effectively.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

14. Most training films help you to understand the technical subject matter more fully.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

15. Most training films and slide presentations motivate you to learn technical material.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

16. Most of the time your instructor refers you to material which supplements your training guide.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

17. Most of the time your technical instructors' presentations just repeat what you were assigned to read.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

18. Most of the time your technical instructor's classroom presentations are not easy to understand.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

19. Most training devices that you use help you to better understand new concepts.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

20. Most of the time additional duties you are assigned interfere with your study.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

21. Most of the time your technical instructor evades answering questions asked during class.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

22. Most of the written tests you receive in technical school are easy to understand.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

23. Most of the time technical classroom temperatures are adequately maintained.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

24. Most paper-and-pencil tests that you are given in technical school you would consider to be thorough.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

25. Most of your technical instruction is spent viewing training films.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

26. Most of your technical instructors' presentations are clarified by examples and illustrations.

Strongly Agree	Agree	Undecided	Agree	Strongly Disagree
( )	( )	( )	( )	( )

27. Most of your technical instructors appear interested in their subject matter.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

28. Most of what you are taught in technical school will help you get a better civilian job.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

29. Most of the time your instructor thoroughly explains new technical material.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

30. Most of the time technical school classroom lights are sufficiently bright.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

31. Most of your student study guides are easy to understand.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

32. Most of the training literature seems related to course objectives.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

33. Most of the time you are informed of the training objectives of each class session.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

34. Most of your technical school instructors make you think they are experienced teachers.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

35. Most of your technical school classrooms are properly ventilated.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

36. Most of the time you have to wait one or more weeks before you know what your score is on a particular technical school test.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

37. Most of the time you are not given enough time to finish your technical school tests.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

38. Most of your scores on written tests reflect how well you can perform your USAF job specialty.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

39. Most of the time your instructor must supplement the training literature because he says it is not current.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

40. Most of the time instructional television is used in your technical training.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

41. Most technical school classroom lectures help you develop the new USAF skill you are trying to learn.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

42. Most of the time your instructor assists you individually by clearly explaining difficult technical material.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

43. Most of the time you need individual assistance to learn technical material.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

44. Most of your technical instructors stimulate class participation.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

45. Most of the time in technical school you are pressed to learn material at a faster rate than you are capable.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

46. Most of the time you should be given additional tests within a block in technical school.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

47. Most of the time your technical training equipment is not operational.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

48. Most of your technical instructors motivate you to learn your USAF speciality.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

49. Most of your skills are being properly used by the Air Force.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

50. Most of the time the noise in your technical school classroom is maintained at a minimun.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

51. Most daily class sessions your technical instructor gives you some personalized instruction.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

52. Most of the time in technical school you feel antimilitary because you are against the war in Vietnam.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

53. Most of the time in technical school you feel you are wasting four years of your life by being in the Air Force.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

54. Most of the time in technical school you feel like making the Air Force your career because you could not get a better paying job as a civilian.

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
( )	( )	( )	( )	( )

55. Most of the time in technical school your anti-Establishment views come into direct conflict with your military training.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
( )	( )	( )	( )	( )

APPENDIX III. GUTTMAN INSTRUCTIONS AND ITEMS

Please read the following items and indicate your reply to each. Place a check mark (√) in front of that given response which best approximates your own percentage estimate of the occurrence of each event. Your estimate should be based on the calculated number in every hundred.

Example: What percentage of the time is Lt Fuzz in trouble with Gen Halftrack?

( ) 100% of the time
( ) 75% of the time
( ) 50% of the time
( ) 25% of the time
( ) 0% of the time

If you estimate that Lt Fuzz is in trouble with Gen Halftrack 75% of the time place a check mark (√) in front of 75% of the time. If you estimate that Lt Fuzz is in trouble with Gen Halftract 60% of the time place a check mark in front of 50% of the time because 60% is better approximated by 50% than by 75%. 60% is closer to 50% than to 75%.

1. What percentage of time during technical school class days do you have available for individual study?
   ( ) 100% of the time.
   ( ) 75% of the time.
   ( ) 50% of the time.
   ( ) 25% of the time.
   ( ) 0% of the time.

2. What percentage of the time are technical school classrooms too small for the number of students in your class?
   ( ) 0% of the time.
   ( ) 25% of the time.
   ( ) 50% of the time.
   ( ) 75% of the time.
   ( ) 100% of the time.

3. What percentage of the time in technical school is six hours of class each working day tiresome?
   ( ) 100% of the time.
   ( ) 75% of the time.
   ( ) 50% of the time.
   ( ) 25% of the time.
   ( ) 0% of the time.

4. What percentage of the time in technical school is the training so regimented that the learning environment is diminished?
   ( ) 100% of the time.
   ( ) 75% of the time.
   ( ) 50% of the time.
   ( ) 25% of the time.
   ( ) 0% of the time.

5. What percentage of your formal education did the Air Force consider in assigning you to a particular technical school?
   ( ) 100% of your education.
   ( ) 75% of your education.
   ( ) 50% of your education.
   ( ) 25% of your education.
   ( ) 0% of your education.

6. What percentage of your instructor's presentations repeat what you were assigned to read?
   ( ) 0% of the presentations.
   ( ) 25% of the presentations.
   ( ) 50% of the presentations.
   ( ) 75% of the presentations.
   ( ) 100% of the presentations.

7. What percentage of the time does your student squadron set aside each class night a sufficient amount of time for sleep?
   ( ) 100% of the time.
   ( ) 75% of the time.
   ( ) 50% of the time.
   ( ) 25% of the time.
   ( ) 0% of the time.

8. What percentage of your instructors appear not to know their technical subject matter?
   ( ) 0% of the instructors.
   ( ) 25% of the instructors.
   ( ) 50% of the instructors.
   ( ) 75% of the instructors.
   ( ) 100% of the instructors.

9. What percentage of your training literature is comprehensible?
   ( ) 100% of the literature.
   ( ) 75% of the literature.
   ( ) 50% of the literature.
   ( ) 25% of the literature.
   ( ) 0% of the literature.

10. What percentage of your technical instructors appear to be well educated?
   ( ) 0% of your instructors.
   ( ) 25% of your instructors.
   ( ) 50% of your instructors.
   ( ) 75% of your instructors.
   ( ) 100% of your instructors.

11. What percentage of your training literature actually teaches you how to perform your new USAF job speciality?
   ( ) 100% of your training literature.
   ( ) 75% of your training literature.
   ( ) 50% of your training literature.
   ( ) 25% of your training literature.
   ( ) 0% of your training literature.

12. What percentage of your technical instructor's classroom presentations are well organized?
   ( ) 100% of the presentations.
   ( ) 75% of the presentations.
   ( ) 50% of the presentations.
   ( ) 25% of the presentations.
   ( ) 0% of the presentations.

13. What percentage of the time is the noise level of your barracks low enough to permit you to study effectively?
   ( ) 0% of the time.
   ( ) 25% of the time.
   ( ) 50% of the time.
   ( ) 75% of the time.
   ( ) 100% of the time.

14. What percentage of training films help you to understand the technical subject matter more fully?
   ( ) 0% of the training films.
   ( ) 25% of the training films.
   ( ) 50% of the training films.
   ( ) 75% of the training films.
   ( ) 100% of the training films.

15. What percentage of training films and slide presentations motivate you to learn technical material?
( ) 0% of the training films and slides.
( ) 25% of the training films and slides.
( ) 50% of the training films and slides.
( ) 75% of the training films and slides.
( ) 100% of the training films and slides.

16. What percentage of the time does your instructor refer you to material which supplements your training guide?
( ) 0% of the time.
( ) 25% of the time.
( ) 50% of the time.
( ) 75% of the time.
( ) 100% of the time.

17. What percentage of your technical instructor's presentations just repeat what you were assigned to read?
( ) 0% of the presentations.
( ) 25% of the presentations.
( ) 50% of the presentations.
( ) 75% of the presentations.
( ) 100% of the presentations.

18. What percentage of the time are your technical instructor's presentations not easy to understand?
( ) 100% of the time.
( ) 75% of the time.
( ) 50% of the time.
( ) 25% of the time.
( ) 0% of the time.

19. What percentage of training devices help you to better understand new concepts?
( ) 100% of the training devices.
( ) 75% of the training devices.
( ) 50% of the training devices.
( ) 25% of the training devices.
( ) 0% of the training devices.

20. What percentage of the time do your additional duties interfere with your study?
( ) 100% of the time.
( ) 75% of the time.
( ) 50% of the time.
( ) 25% of the time.
( ) 0% of the time.

21. What percentage of the time does your technical instructor evade answering questions asked during class?
( ) 0% of the time.
( ) 25% of the time.
( ) 50% of the time.
( ) 75% of the time.
( ) 100% of the time.

22. What percentage of written tests that you receive in technical school are easy to understand?
( ) 0% of the tests.
( ) 25% of the tests.
( ) 50% of the tests.
( ) 75% of the tests.
( ) 100% of the tests.

23. What percentage of the time are technical school classroom temperatures adequately maintained?
( ) 100% of the time.
( ) 75% of the time.
( ) 50% of the time.
( ) 25% of the time.
( ) 0% of the time.

24. What percentage of the paper-and-pencil tests that you are given in technical school would you consider to be thorough?
( ) 100% of the tests.
( ) 75% of the tests.
( ) 50% of the tests.
( ) 25% of the tests.
( ) 0% of the tests.

25. What percentage of your technical instruction is spent viewing training films?
( ) 0% of your instruction.
( ) 25% of your instruction.
( ) 50% of your instruction.
( ) 75% of your instruction.
( ) 100% of your instruction.

26. What percentage of your technical instructor's presentations are clarified by examples and illustrations?
( ) 100% of the presentations.
( ) 75% of the presentations.
( ) 50% of the presentations.
( ) 25% of the presentations.
( ) 0% of the presentations.

27. What percentage of your technical instructors appear interested in their subject matter?
( ) 0% of the instructors.
( ) 25% of the instructors.
( ) 50% of the instructors.
( ) 75% of the instructors.
( ) 100% of the instructors.

28. What percentage of what you are taught in technical school will help you get a better civilian job?
( ) 0% of what you are taught.
( ) 25% of what you are taught.
( ) 50% of what you are taught.
( ) 75% of what you are taught.
( ) 100% of what you are taught.

29. What percentage of the time does your instructor thoroughly explain new technical material?
( ) 100% of the time.
( ) 75% of the time.
( ) 50% of the time.
( ) 25% of the time.
( ) 0% of the time.

30. What percentage of the time are technical school classroom lights sufficiently bright?
( ) 0% of the time.
( ) 25% of the time.
( ) 50% of the time.
( ) 75% of the time.
( ) 100% of the time.

31. What percentage of your student study guides are easy to understand?
( ) 0% of the study guides.
( ) 25% of the study guides.
( ) 50% of the study guides.
( ) 75% of the study guides.
( ) 100% of the study guides.

32. What percentage of the training literature seems related to course objectives?
( ) 0% of the training literature.
( ) 25% of the training literature.
( ) 50% of the training literature.
( ) 75% of the training literature.
( ) 100% of the training literature.

33. What percentage of the time are you informed of the training objectives of each class session?
( ) 100% of the time.
( ) 75% of the time.
( ) 50% of the time.
( ) 25% of the time.
( ) 0% of the time.

34. What percentage of your technical school instructors do you think are experienced teachers?
( ) 100% of the instructors.
( ) 75% of the instructors.
( ) 50% of the instructors.
( ) 25% of the instructors.
( ) 0% of the instructors.

35. What percentage of your technical school classrooms are properly ventilated?
( ) 0% of the classrooms.
( ) 25% of the classrooms.
( ) 50% of the classrooms.
( ) 75% of the classrooms.
( ) 100% of the classrooms.

36. What percentage of the time do you have to wait one or more weeks before you know what your score is on a particular technical school test?
( ) 100% of the time.
( ) 75% of the time.
( ) 50% of the time.
( ) 25% of the time.
( ) 0% of the time.

37. What percentage of the time are you not given enough time to finish your technical school tests?
( ) 0% of the time.
( ) 25% of the time.
( ) 50% of the time.
( ) 75% of the time.
( ) 100% of the time.

38. What percentage of your scores on written tests reflect how well you can perform your USAF job speciality?
( ) 100% of your scores.
( ) 75% of your scores.
( ) 50% of your scores.
( ) 25% of your scores.
( ) 0% of your scores.

39. What percentage of the time must your instructor supplement training literature because he says it is not current?
( ) 0% of the time.
( ) 25% of the time.
( ) 50% of the time.
( ) 75% of the time.
( ) 100% of the time.

40. What percentage of the time is instructional television used in your technical training?
( ) 100% of the time.
( ) 75% of the time.
( ) 50% of the time.
( ) 25% of the time.
( ) 0% of the time.

41. What percentage of technical-school-classroom lectures help you develop the new USAF skill you are trying to learn?
( ) 100% of the lectures.
( ) 75% of the lectures.
( ) 50% of the lectures.
( ) 25% of the lectures.
( ) 0% of the lectures.

42. What percentage of the time does your instructor assist you individually by clearly explaining difficult technical materials?
( ) 0% of the time.
( ) 25% of the time.
( ) 50% of the time.
( ) 75% of the time.
( ) 100% of the time.

43. What percentage of the time do you need individual assistance to learn technical material?
( ) 0% of the time.
( ) 25% of the time.
( ) 50% of the time.
( ) 75% of the time.
( ) 100% of the time.

44. What percentage of your technical instructors stimulate class participation?
( ) 100% of your instructors.
( ) 75% of your instructors.
( ) 50% of your instructors.
( ) 25% of your instructors.
( ) 0% of your instructors.

45. What percentage of the time in technical school are you pressed to learn material at a faster rate than you are capable?
( ) 100% of the time.
( ) 75% of the time.
( ) 50% of the time.
( ) 25% of the time.
( ) 0% of the time.

46. What percentage of tests should you additionally be given within a block in technical school?
( ) 0% of tests.
( ) 25% of tests.
( ) 50% of tests.
( ) 75% of tests.
( ) 100% of tests.

47. What percentage of the time is your technical training equipment not operational?
( ) 0% of the time.
( ) 25% of the time.
( ) 50% of the time.
( ) 75% of the time.
( ) 100% of the time.

48. What percentage of your technical instructors motivate you to learn your USAF speciality?
( ) 100% of your instructors.
( ) 75% of your instructors.
( ) 50% of your instructors.
( ) 25% of your instructors.
( ) 0% of your instructors.

49. What percentage of your skills is the Air Force using properly?
( ) .0% of your skills.
( ) 25% of your skills.
( ) 50% of your skills.
( ) 75% of your skills.
( ) 100% of your skills.

50. What percentage of the time is the noise in your technical school class maintained at a minimum?
( ) 100% of the time.
( ) 75% of the time.
( ) 50% of the time.
( ) 25% of the time.
( ) 0% of the time.

51. What percentage of daily class sessions does your technical instructor give you some personalized instruction?
( ) 0% of daily class sessions.
( ) 25% of daily class sessions.
( ) 50% of daily class sessions.
( ) 75% of daily class sessions.
( ) 100% of daily class sessions.

52. What percentage of the time in technical school do you feel antimilitary because you are against the war in Vietnam?
( ) 100% of the time.
( ) 75% of the time.
( ) 50% of the time.
( ) 25% of the time.
( ) 0% of the time.

53. What percentage of the time in technical school do you feel you are wasting four years of your life by being in the Air Force?
( ) 0% of the time.
( ) 25% of the time.
( ) 50% of the time.
( ) 75% of the time.
( ) 100% of the time.

54. What percentage of the time in technical school do you feel like making the Air Force your career because you could not get a better paying job as a civilian?
( ) 0% of the time.
( ) 25% of the time.
( ) 50% of the time.
( ) 75% of the time.
( ) 100% of the time.

55. What percentage of the time in technical school do your anti-Establishment views come into direct conflict with your military training?
( ) 100% of the time.
( ) 75% of the time.
( ) 50% of the time.
( ) 25% of the time.
( ) 0% of the time.

APPENDIX IV. JUSTIFICATION FOR USING PRINCIPAL-COMPONENT ANALYSIS, APPROXIMATING COMMUNALITIES BY SQUARED MULTIPLE CORRELATIONS, AND EMPLOYING VARIMAX ROTATION

Principal-component analysis was selected as the factor analytic method in this investigation since its objective is to extract the maximum variance. An important property of the method, insofar as the summarization of data is concerned, is that each component, in turn, makes a maximum contribution to the sum of the variances of n variables. In contrast to this maximum variance approach, the classical factor analysis method is designed to maximally reproduce intercorrelations. Common factors account for the correlations among variables, while each unique factor accounts for the remaining variance of that variable (Harman, 1967).

Communalities were approximated by the insertion in the principal diagonal of the squared multiple correlation (SMC) of each variable with the remaining n -1 observed variables. Wrigley (1957) suggested the SMCs be called "observed communalities" since they measure predictable common variance among the observed correlations. Also, SMCs are certainly objectively and uniquely determined. The SMC has another very important property which recommended it as an approximation to communality – it is the lower bound for the communality (Dwyer, 1939). Largely because of this property, Guttman (1956) stated that the SMC is the "best possible" estimate of communality.

According to Kaiser (1958), the Varimax criterion for rotation has several advantages over the Quartimax method. The emphasis in Varimax is on "cleaning up" factors rather than variables. Each Varimax rotation tends to yield high loadings for a few variables; while the rest of the loadings in the factor will be zero or near zero. One important advantage of the Varimax solution is that the resulting factors tend to be invariant under changes in the composition of the test items. If the purpose of multiple-factor analysis is to allow inferences about the dimensionality of some psychological domain on the basis of a sample of n items drawn from that domain, then this invariance property is of the utmost importance. Apparently, small changes in the sample of items used should not affect the basic inferences drawn (Kaiser, 1958, p. 195).

APPENDIX V. PRINCIPAL-COMPONENT ANALYSIS AND ITS ASSOCIATED STATISTICS FOR LIKERT ITEMS

The means and standard deviations for the 55 Likert items are reported in Table 2. Thirty-one eigenvalues were obtained which were positive; therefore, their 31 corresponding eigenvectors were the only ones preserved for further analysis. Obviously, negative eigenvalues, and their associated imaginery factor pattern coefficients, must be extraneous to a practical problem. The positive eigenvalues are presented in Table 3. The eigenvectors are converted to factor pattern coefficients or factor loadings by multiplying each element of the eigenvector by the square root of the corresponding eigenvalue. Thus, the eigenvalues listed in Table 3 are the standard deviations along the corresponding principal factors, rather than variances, as is the case when the eigenvectors are used as factor loadings. Table 4 presents the principal factor pattern. Using the procedure mentioned by Harman (1967, p. 163) for approximating the standard error of the factor loadings, it was found that loadings greater than 0.2685 are significant at the .05 level. Hence, only loadings 0.2685 or larger are reported in Table 4 and Table 6. The communalities, which give the proportion of the variance for each of the original items which were preserved in the factor solution, are listed in Table 5. These range from 0.09520 to 0.63236.

Varimax rotation was conducted in the hope that the new factors would be less difficult to interpret. The nature of the Varimax critierion is such that general factors, if originally present in the principal-component solution, tend to be destroyed during rotation. Because the student attitude scores very definitely exhibited a general factor (training disposition), this property of the original principal-component solution was undesirable. The main reason for this undesirability was that these quantified attitudes were more easily interpreted if several specific factors were partialed out. The initial principal-component solution did not seem to accomplish this by having one general factor independent of other factors. During Varimax rotation, however, much of the variance associated with the first factor was distributed to other factors, thus producing several specific and more interpretable factors.

Table 2. **Means and Standard Deviations of Likert Items**
(N = 287)

Item	Mean	SD	Item	Mean	SD
1	3.27172	1.22158	29	3.76300	0.73353
2	3.68635	1.00310	30	3.96857	0.67605
3	2.96161	1.22981	31	3.15673	1.07407
4	2.94419	1.29427	32	3.67938	0.82891
5	2.49123	1.22576	33	3.62711	0.85506
6	2.55395	0.98397	34	3.18461	1.00559
7	3.20551	1.11075	35	3.70725	0.85977
8	3.98252	0.86685	36	4.46683	0.79648
9	3.32397	1.04590	37	3.63060	1.21879
10	3.68286	0.86934	38	2.10795	1.00982
11	2.69680	1.04550	39	3.11143	0.98667
12	3.70028	0.86142	40	4.30656	0.89875
13	3.10795	1.05718	41	3.31004	0.99543
14	3.31352	1.03060	42	3.58878	0.95251
15	3.03827	1.04541	43	3.61317	1.00360
16	3.48425	0.88039	44	3.58878	0.91123
17	2.84314	0.99287	45	3.44593	1.05597
18	3.73512	0.82333	46	3.36579	1.13523
19	3.67938	0.79002	47	3.20551	1.19565
20	2.75603	1.25285	48	3.26474	0.99626
21	4.12537	0.73256	49	2.61318	1.21479
22	3.05917	1.13739	50	3.75952	0.86179
23	3.59227	0.94110	51	3.31701	0.98616
24	3.32398	0.98388	52	3.98252	1.12644
25	4.21945	0.71245	53	3.63408	1.27175
26	3.70028	0.80694	54	1.80830	1.10379
27	3.72467	0.81774	55	3.79785	1.25473
28	2.90236	1.14239			

Table 3. **Positive Eigenvalues for Principal-Components Analysis of the Likert Items**

Eigenvalue Number	Eigenvalue	Cumulative Proportion of Total Variance
1	7.56190	0.13749
2	2.90655	0.19034
3	2.14488	0.22933
4	1.70138	0.26027
5	1.30477	0.28399
6	1.18930	0.30561
7	1.02831	0.32431
8	0.99972	0.34249
9	0.94599	0.35969
10	0.78362	0.37393
11	0.75137	0.38760
12	0.67947	0.39995
13	0.61149	0.41107
14	0.52920	0.42069
15	0.50161	0.42981
16	0.47956	0.43853
17	0.36896	0.44524
18	0.34684	0.45154
19	0.29077	0.45683
20	0.27029	0.46174
21	0.23529	0.46602
22	0.21261	0.46989
23	0.20403	0.47360
24	0.17894	0.47685
25	0.15679	0.47970
26	0.15357	0.48249
27	0.12371	0.48474
28	0.09254	0.48642
29	0.05271	0.48738
30	0.03978	0.48811
31	0.01614	0.48840

Table 4. **Principal Factor Pattern of the Likert Items**

Item	Factor I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
1	.3245							.2701		−.2980					
2	.3125	−.2797				−.2778									
3	.4065														
4	.4648														
5			.4547												
6				−.3048		−.4524									
7															
8	.4230														
9				.2715											
10	.5805														
11	.4141		.3355												
12	.4914														
13		−.4080													
14	.3567					.2788		−.2764							
15	.4199						.3180	−.2707							
16							.2690								
17				−.3353		−.4675									
18	.3991														
19	.2683														
20	.3604	−.4683													
21	.4470		−.3416												
22	.3054														
23					−.4524	−.3040									
24	.4157														
25			−.3509												
26	.5195														
27	.4131	.3033													
28	.3601	.3644	.3184												
29	.6827														
30	.3320														
31	.4610		.2778												
32	.4741													−.3249	
33	.4493														
34	.3715														
35	.2966				−.3878										
36	.2810		−.3284												
37	.3046	−.4363													
38											−.2741				
39															
40		−.2757	−.3437												
41	.4755														
42	.3751	.3264	−.2671												
43	.2840					.2811									
44	.5409														
45	.3112	−.4919													
46		−.2992											−.3339		
47	.3042														
48	.5576	.3325													
49	.3881		.4933												
50															
51	.3056	.3142													
52	.4293			−.4969											
53	.5080			−.4904											
54					−.2831						−.3088				
55	.4453	−.2921		−.4570											

Note. — Only loadings equal to or greater than 0.2685 are included since these are significant at the .05 level.

Table 5. **Check on Communalities for Likert Items**

Item	Original h^2	Final h^2	Difference
1	0.30930	0.30929	−0.00001
2	0.28219	0.28218	−0.00001
3	0.30977	0.30976	−0.00001
4	0.28648	0.28648	−0.00001
5	0.29893	0.29892	−0.00000
6	0.44046	0.44045	−0.00001
7	0.17399	0.17399	−0.00000
8	0.33474	0.33473	−0.00001
9	0.32285	0.32285	−0.00001
10	0.43996	0.43995	−0.00001
11	0.40025	0.40024	−0.00001
12	0.35222	0.35222	−0.00001
13	0.26528	0.26528	−0.00001
14	0.37850	0.37849	−0.00001
15	0.41800	0.41800	−0.00001
16	0.24129	0.24129	−0.00000
17	0.46272	0.46271	−0.00001
18	0.25613	0.25612	−0.00001
19	0.20623	0.20623	−0.00000
20	0.40281	0.40280	−0.00001
21	0.35349	0.35349	−0.00001
22	0.25971	0.25970	−0.00001
23	0.40357	0.40357	−0.00001
24	0.25225	0.25224	−0.00001
25	0.21784	0.21784	−0.00000
26	0.41827	0.41827	−0.00001
27	0.35745	0.35744	−0.00001
28	0.40777	0.40776	−0.00001
29	0.60453	0.60452	−0.00001
30	0.35630	0.35629	−0.00001
31	0.43366	0.43366	−0.00001
32	0.30743	0.30743	−0.00001
33	0.23675	0.23674	−0.00000
34	0.29673	0.29673	−0.00001
35	0.44383	0.44383	−0.00001
36	0.21894	0.21893	−0.00000
37	0.39646	0.39645	−0.00001
38	0.19423	0.19422	−0.00000
39	0.16424	0.16423	−0.00000
40	0.36452	0.36452	−0.00001
41	0.36687	0.36686	−0.00001
42	0.46000	0.45999	−0.00001
43	0.28933	0.28932	−0.00001
44	0.39442	0.39441	−0.00001
45	0.43059	0.43058	−0.00001
46	0.19162	0.19162	−0.00000
47	0.18112	0.18112	−0.00000
48	0.48646	0.48645	−0.00001
49	0.45201	0.45201	−0.00001
50	0.09520	0.09520	−0.00000
51	0.36214	0.36213	−0.00001
52	0.48833	0.48832	−0.00001
53	0.63236	0.63235	−0.00001
54	0.19208	0.19207	−0.00000
55	0.54257	0.54256	−0.00001

Table 6. **Varimax Rotated Pattern of the Likert Items**

	Factor							
Item	I	II	III	IV	V	VI	VII	VIII
1		0.44746						
2		0.30975			0.35954			
3			0.44385					
4		0.31596		0.33202				
5			0.52114					
6						0.64262		
7				0.31211				
8	0.54152							0.46022
9								
10	0.56844							
11			0.55255					
12	0.55099							
13		0.35672		0.31403			0.53546	
14							0.55396	
15								−0.32287
16						0.65472		
17								
18	0.29489						0.32398	
19								
20		0.45333		0.38843				
21	0.56025							0.36612
22								
23					0.61306		0.32417	
24								
25								
26	0.57263							
27	0.53212							
28			0.53273					
29	0.70374							
30					0.48825			0.46813
31			0.31896					
32	0.34780		0.27596					
33	0.29229	0.27756						
34	0.44278							
35					0.63518			
36		0.31891						
37		0.50385						
38		0.37853						0.32458
39								
40		0.41360						
41			0.44179					
42	0.52193							
43		0.47545						
44	0.50124							
45		0.62687						
46		0.37748						
47								
48	0.43957		0.46535					
49			0.50335	0.40667				−0.34425
50								
51	0.42177							
52				0.60600				
53				0.73385				
54				0.33252				
55				0.66615				

Note. — Only loadings equal to or greater than 0.2685 are included since these are significant at the .05 level.

APPENDIX VI. PRINCIPAL-COMPONENT ANALYSIS AND ITS ASSOCIATED STATISTICS FOR GUTTMAN ITEMS

The means and standard deviations for the 55 Guttman items are presented in Table 7. Thirty-two eigenvalues were obtained which were positive; therefore, their 32 corresponding eigenvectors were the only ones preserved for further analysis. The positive eigenvalues are presented in Table 8; Table 9 presents the principal factor pattern. Only loadings 0.2685 or larger are reported in Table 9 and Table 11 since they were found to be significant at the .05 level using Harman's (1967, p. 163) procedures. The communalities are listed in Table 10; these range from 0.04895 to 0.66491. Only the first eight factors were rotated since approximately 92 percent of all significant factor loadings appeared within these eight factors.

Table 7. **Means and Standard Deviations of Guttman Items**
(N = 288)

Item	Mean	SD	Item	Mean	SD
1	2.22216	0.88695	29	3.82633	0.95785
2	4.36452	0.99251	30	4.52076	0.84606
3	3.39924	1.33703	31	3.59716	0.93941
4	3.53466	1.33256	32	3.97910	0.91802
5	2.41660	1.37166	33	3.85780	1.13719
6	2.68743	1.03907	34	3.47910	1.00845
7	3.12841	1.63394	35	4.06938	1.11468
8	4.19091	1.04345	36	4.87493	0.49912
9	3.65966	0.91189	37	4.18744	1.19211
10	3.88882	0.91530	38	2.45132	1.07118
11	2.89924	1.00880	39	3.84021	0.86482
12	4.00688	0.82213	40	4.67007	0.73646
13	3.03813	1.41982	41	3.21869	1.08395
14	2.77772	1.26017	42	3.17702	1.27144
15	2.44785	1.17643	43	3.98258	0.82410
16	2.84021	1.13026	44	3.66313	1.06956
17	2.89577	1.05074	45	3.95827	1.09718
18	4.06938	0.72920	46	4.31938	0.97103
19	3.30550	1.06757	47	3.89577	1.11821
20	3.57632	1.45345	48	3.31938	1.19317
21	4.69785	0.66447	49	2.77424	1.17214
22	3.52771	1.06541	50	3.98605	1.15359
23	3.95132	1.04816	51	2.09022	0.92139
24	3.56591	1.06044	52	4.38882	1.17824
25	4.30549	0.61089	53	3.98605	1.34076
26	3.45480	0.97960	54	1.51382	1.04587
27	3.89924	0.98785	55	4.20827	1.22614
28	2.69091	1.29791			

Table 8. **Positive Eigenvalues for the Principal-Components Analysis of the Guttman Items**

Eigenvalue Number	Eigenvalue	Cumulative Proportion of Total Variance
1	7.07854	0.12870
2	2.68444	0.17751
3	2.24375	0.21830
4	1.79378	0.25092
5	1.42330	0.27680
6	1.34919	0.30133
7	1.23941	0.32386
8	1.05357	0.34302
9	0.97052	0.36066
10	0.78895	0.37501
11	0.74953	0.38864
12	0.65629	0.40057
13	0.65121	0.41241
14	0.54278	0.42228
15	0.51237	0.43159
16	0.43277	0.43946
17	0.40337	0.44679
18	0.39586	0.45399
19	0.36708	0.46067
20	0.31942	0.46647
21	0.23868	0.47081
22	0.21799	0.47478
23	0.19018	0.47823
24	0.17963	0.48150
25	0.16379	0.48448
26	0.14790	0.48717
27	0.11880	0.48933
28	0.09715	0.49109
29	0.06018	0.49219
30	0.04888	0.49308
31	0.02732	0.49357
32	0.01847	0.49391

Table 9. **Principal Factor Pattern of the Guttman Items**

Item	Factor I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
1															
2			-.2942												
3	.3804			.3701						.3311					
4	.4495														
5				.3617											
6					-.6347	.3520									
7							-.3123	-.3171							
8															
9	.4123		-.3547				.3132								
10	.5939														
11	.4633	.3026													
12	.5852			-.2816											
13								-.2812							
14		.3823			-.2761	-.4030		.4095							
15	.3150	.3729			-.2908	-.3160		.3680							
16		.3057													
17		-.3019			-.5756	.3977									
18	.3520														
19	.3843														
20		-.5110								.2792					
21	.4066												.2687		
22	.3499		-.4207												
23	.3739		-.3458				-.4259								
24	.3574														
25		-.4045													
26	.4684											-.2767			
27	.6664														
28	.4145		.3789												
29	.4538			-.3315											
30	.2986		-.3043												
31	.4999		-.2969				.3535								
32	.5455														
33	.4378														
34	.5321														
35	.2870						-.4330								
36									.3918						
37			-.3375												
38	.3145			.4416											
39	.2697		-.3026												
40		-.3419		-.2963											
41	.5043														
42		.2775													
43		-.3421	-.2736												
44	.5413														
45	.3098		-.3886												
46															
47	.3135														
48	.6139		.2991												
49	.4335			.3626											
50										-.2913					
51		.3704													
52	.3209	-.4704													
53	.4458	-.4753											-.2709		
54															
55		.4852													

Note. — Only loadings equal to or greater than 0.2685 are included since they are significant at the .05 level.

Table 10. **Check on Communalities for Guttman Items**

Item	Original h^2	Final h^2	Difference
1	0.04895	0.04895	−0.00000
2	0.19474	0.19474	−0.00000
3	0.29831	0.29831	−0.00000
4	0.31488	0.31487	−0.00001
5	0.24357	0.24357	−0.00000
6	0.65241	0.65240	−0.00001
7	0.27036	0.27036	−0.00000
8	0.08799	0.08799	−0.00000
9	0.49721	0.49720	−0.00001
10	0.44843	0.44842	−0.00001
11	0.40380	0.40380	−0.00001
12	0.46983	0.46982	−0.00001
13	0.30753	0.30753	−0.00000
14	0.66491	0.66490	−0.00001
15	0.56057	0.56057	−0.00001
16	0.26150	0.26150	−0.00000
17	0.62349	0.62348	−0.00001
18	0.20535	0.20535	−0.00000
19	0.26205	0.26204	−0.00000
20	0.45197	0.45196	−0.00001
21	0.23557	0.23557	−0.00000
22	0.34141	0.34141	−0.00000
23	0.48942	0.48941	−0.00001
24	0.25136	0.25136	−0.00000
25	0.29370	0.29369	−0.00000
26	0.32462	0.32461	−0.00000
27	0.53326	0.53325	−0.00001
28	0.44381	0.44381	−0.00001
29	0.41870	0.41870	−0.00000
30	0.30240	0.30240	−0.00000
31	0.54448	0.54447	−0.00001
32	0.40288	0.40288	−0.00001
33	0.25973	0.25973	−0.00000
34	0.39599	0.39599	−0.00001
35	0.40339	0.40338	−0.00000
36	0.14359	0.14359	−0.00000
37	0.22191	0.22190	−0.00000
38	0.38074	0.38074	−0.00000
39	0.25168	0.25167	−0.00000
40	0.32542	0.32542	−0.00000
41	0.37739	0.37738	−0.00000
42	0.27485	0.27484	−0.00000
43	0.25402	0.25402	−0.00000
44	0.43366	0.43366	−0.00001
45	0.28024	0.28024	−0.00000
46	0.10487	0.10487	−0.00000
47	0.14655	0.14654	−0.00000
48	0.47539	0.47538	−0.00001
49	0.41795	0.41794	−0.00001
50	0.11579	0.11579	−0.00000
51	0.31234	0.31234	−0.00000
52	0.38010	0.38010	−0.00000
53	0.53025	0.53024	−0.00001
54	0.10597	0.10597	−0.00000
55	0.42319	0.42319	−0.00001

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Table 11. **Varimax Rotated Pattern of the Guttman Items**

Items	Factor I	II	III	IV	V	VI	VII	VIII
1								
2							0.37930	
3				0.45630				
4		0.38879						
5				0.47851				
6					0.80220			
7								0.50232
8								
9			0.65310					
10	0.58428							
11				0.44991				
12	0.65333							
13								0.50122
14						0.79003		
15						0.70852		
16	0.29431							
17					0.77577			
18			0.28232					
19				0.34072		0.27140		
20		0.57840						
21	0.43048							
22			0.52574					
23								
24			0.32810					
25						−0.35547		
26	0.51339							
27	0.62609							
28	0.33974			0.54140				
29	0.62441							
30							0.49462	
31			0.67926					
32	0.28877		0.48467					
33	0.34483							
34	0.55452							
35							0.61078	
36								
37							0.35319	
38				0.57094				
39			0.31070				0.33795	
40		0.41571		−0.30221				
41	0.27944			0.49067				
42	0.43602							
43		0.39051						
44	0.59949							
45		0.26907	0.36146					
46								
47								
48	0.57016			0.31741				
49		0.31526		0.51887				
50							0.30795	
51		−0.32752						0.37151
52		0.58548						
53		0.62410		0.30235				
54								
55		0.60976						

Note. — Only loadings equal to or greater than 0.2685 are included since these are significant at the .05 level.

APPENDIX VII. DSCRIM AND RELATED STATISTICS FOR LIKERT ITEMS

The Wilks' lambda criterion (λ) for the discriminating power of the Likert items among the three groups was 0.185 which had an associated probability of 0.000. Thus, the chance of producing group differences this large or larger by drawing three random samples from a 55 dimensional multivariate swarm was essentially zero. In Table 12a, it can be seen that 100 percent of the trace was accounted for by two discriminant functions. The group centroids computed relative to these functions are presented in Table 12b. The correlations listed in Table 13 indicated the significant contributors to group separation along the first and second discriminant functions. The univariate F tests reported in Table 14 revealed that the groups responded significantly differently on 16 of the 55 items. For each of these 16 items the *t* statistic was computed for all possible pairs of group means; these *t* values are presented in Table 15. The group means for all items are tabulated in Table 16.

Table 12a. **Significance of the Discriminant Functions χ^2 Approximations for the Likert Data**

Function	Percent of Trace	Eigenvalues	df	χ^2	p
I	68.20	1.884	56	273.267	0.000
II	31.80	.878	54	162.664	0.000

Trace = 2.762; λ = 0.185; F(110,460) = 5.552; p = 0.000

Table 12b. **Group Centroids in the Discriminant Space for the Likert Data**

Group	Function I	Function II
Officers	1.504	1.928
NCOs	0.637	3.509
Airmen	−0.989	2.001

Table 13. **Correlations Between Likert Items and the Discriminant Functions**

Item	Function I	Function II	Item	Function I	Function II
1	0.2450*	0.0225	29	0.0060	0.0917
2	0.1434	−0.0632	30	0.1208	−0.0277
3	−0.0940	0.4503*	31	0.1468	0.0648
4	0.4747*	0.2417*	32	−0.0114	0.0094
5	−0.1787	0.1936*	33	0.2287*	0.2183*
6	0.0349	0.2056*	34	0.0847	0.0783
7	0.2577*	0.1505*	34	0.0753	0.0116
8	0.0220	0.1109	36	0.0915	−0.0543
9	0.1277	−0.0239	37	0.4616*	0.0807
10	0.2411*	0.0317	38	−0.1965*	−0.0228
11	−0.1143	0.0120	39	−0.0288	0.0974
12	0.1503*	0.1085	40	0.2279*	0.0752
13	0.3984*	0.0301	41	−0.0837	0.3024*
14	0.1156	0.0212	42	−0.1638*	0.0163
15	0.0548	0.2415*	43	0.2114*	0.1184
16	−0.1526*	0.1055	44	0.0950	0.2584*
17	−0.0039	0.1581*	45	0.2934*	−0.1828*
18	0.2726*	−0.0198	46	0.1506*	−0.2132*
19	−0.0965	0.2110*	47	0.3801*	0.0053
20	0.6347*	0.1113	48	−0.0615	0.3093*
21	0.0803	0.0578	49	0.0595	0.3236*
22	0.2112*	−0.1434	50	−0.2046*	0.2800*
23	0.0045	0.1095	51	−0.1212	0.1240
24	−0.1026	0.1816*	52	0.3245*	0.2385*
25	0.0207	0.1445	53	0.3788*	0.5010*
26	0.0444	−0.0551	54	0.2448*	0.1745*
27	0.0045	0.2112*	55	0.4434*	0.3659*
28	−0.3708*	0.6003*			

*$r \geqslant 0.148$ is significant at the .01 level, $N = 287$.

Table 14. **Univariate F Tests for Likert Items**

(dfb = 2; dfw = 284)

Item	F Ratio	p	Item	F Ratio	p
1	5.8303	0.0037	29	0.5686	0.5724
2	2.2072	0.1097	30	1.4185	0.2424
3	15.8854	0.0000*	31	2.3148	0.0985
4	30.0290	0.0000*	32	0.0192	0.9817
5	5.6688	0.0042	33	8.4981	0.0005*
6	2.9826	0.0507	34	1.0809	0.3414
7	8.1031	0.0007*	35	0.5374	0.5905
8	0.8671	0.5757	36	0.9820	0.6225
9	1.5669	0.2087	37	23.5458	0.0000*
10	5.6802	0.0042	38	3.7109	0.0249
11	1.2324	0.2926	39	0.7104	0.5032
12	2.9364	0.0531	40	5.3905	0.0054
13	16.5007	0.0000*	41	7.0571	0.0014
14	1.2820	0.2783	42	2.5515	0.0778
15	4.2789	0.0146	43	5.2670	0.0060
16	2.9603	0.0518	44	5.4775	0.0050
17	1.6811	0.1860	45	10.9929	0.0001*
18	7.2740	0.0012	46	5.3127	0.0057
19	3.9289	0.0202	47	14.7985	0.0000*
20	52.2495	0.0000*	48	7.0347	0.0014
21	0.8251	0.5572	49	7.6775	0.0009*
22	5.7275	0.0040	50	9.7101	0.0002*
23	0.8035	0.5475	51	2.4251	0.0882
24	3.2396	0.0394	52	14.9730	0.0000*
25	1.4396	0.2373	53	38.0017	0.0000*
26	0.3868	0.6853	54	8.0115	0.0007*
27	3.0289	0.0484	55	33.5345	0.0000*
28	49.4664	0.0000*			

*Obviously significant at the .001 level.

Table 15. **Significance of Differences Between Pairs of Group Means on Selected Likert Items**

Item	$\bar{x} - \bar{x}$ Ofs NCO (df = 186)	$\bar{x} - \bar{x}$ Ofs Amn (df = 196)	$\bar{x} - \bar{x}$ NCO Amn (df = 186)
3	5.6412*	2.3226	3.6811*
4	0.5500	0.5316	7.1951*
5	0.5439	2.9724	3.7222*
13	1.8238	5.3912*	3.7873*
20	1.9961	9.7684*	7.8493*
28	10.0800*	6.8027*	2.6736
33	1.5321	2.5659	4.1551*
37	1.4773	6.4856*	4.8407*
45	3.6510*	4.5528*	0.9034
47	1.8519	5.1708*	3.6233*
49	3.2847	0.1638	3.4568*
50	3.9817*	3.1819	0.9959
52	1.8917	4.0400*	5.2980*
53	4.5960*	4.2714*	9.6100*
54	0.7554	3.2271	4.0800*
55	2.6328	5.3375*	7.9761*

*p < .001

Table 16. **Group Means for Likert Items**

	Group				Group		
Item	Officers (N=99)	NCOs (N=89)	Airmen (N=99)	Item	Officers (N=99)	NCOs (N=89)	Airmen (N=99)
1	3.5152	3.3596	2.9495	29	3.7273	3.8315	3.7374
2	3.8485	3.6517	3.5556	30	4.0505	3.9663	3.8889
3	2.5354	3.4944	2.9091	31	3.2525	3.2584	2.9697
4	3.2929	3.3820	2.2020	32	3.6667	3.6854	3.6869
5	2.1616	2.6854	2.6465	33	3.6869	3.8539	3.3636
6	2.4646	2.7640	2.4545	34	3.2121	3.2809	3.0707
7	3.3636	3.4382	2.8687	35	3.7576	3.7303	3.6364
8	3.9495	4.0899	3.9394	36	4.5556	4.4382	4.4040
9	3.4545	3.3258	3.1919	37	4.0606	3.8427	3.0101
10	3.8485	3.7528	3.4545	38	1.9495	2.0449	2.3232
11	2.5859	2.6854	2.8182	39	3.0303	3.2022	3.1111
12	3.7576	3.8202	3.5354	40	4.4444	4.4157	4.0707
13	3.4545	3.2247	2.6566	41	3.0606	3.5955	3.3030
14	3.4040	3.3596	3.1818	42	3.4444	3.5730	3.7475
15	2.9394	3.3034	2.8990	43	3.7273	3.7753	3.3535
16	3.3131	3.5506	3.5960	44	3.5253	3.8427	3.4242
17	2.7475	3.0000	2.7980	45	3.8283	3.3146	3.1818
18	3.9394	3.7640	3.5050	46	3.6566	3.1573	3.2626
19	3.5152	3.8315	3.7071	47	3.5960	3.3034	2.7273
20	3.3636	3.0562	1.8788	48	3.0303	3.5618	3.2323
21	4.1515	4.1798	4.0505	49	2.4444	3.0225	2.4141
22	3.3636	2.9438	2.8586	50	3.4646	3.9663	3.8687
23	3.5354	3.6966	3.5556	51	3.1414	3.4157	3.4040
24	3.1313	3.4831	3.3737	52	4.1414	4.3258	3.5152
25	4.1717	4.3258	4.1717	53	3.6768	4.3708	2.9394
26	3.7576	3.6629	3.6768	54	1.9293	2.0562	1.4646
27	3.6263	3.8989	3.6667	55	4.0101	4.3708	3.0707
28	2.1313	3.5056	3.1313				

APPENDIX VIII. DSCRIM AND RELATED STATISTICS FOR GUTTMAN ITEMS

The lambda criterion for the discriminating power of the Guttman items among the three groups was 0.152 which had an associated probability of 0.000. In Table 17a, it can be seen that 100 percent of the trace was accounted for by two discriminant functions. The group centroids computed relative to these functions are presented in Table 17b. The correlations listed in Table 18 indicated the significant contributors to group separation along the first and second discriminant function. The univariate F tests reported in Table 19 revealed that the groups responded significantly differently on 17 of the 55 items. For each of these 17 items the *t* statistics was computed for all possible pairs of group means; these *t* values are presented in Table 20. The group means for all items are tabulated in Table 21.

Table 17a. **Significance of the Discriminant Functions χ^2 Approximations for the Guttman Data**

Function	Percent of Trace	Eigenvalues	df	χ^2	p
I	68.36	2.235	56	304.098	0.000
II	31.64	1.035	54	183.963	0.000

Trace = 3.2698; $\lambda = 0.152$; F(110,462) = 6.576; p = 0.000

Table 17b. **Group Centroids in the Discriminant Space for the Guttman Data**

	Function	
Group	I	II
Officer	5.1724	1.8944
NCOs	5.1780	3.7047
Airmen	2.6488	2.7549

Table 18. **Correlations Between Guttman Items and the Discriminant Functions**

Item	Function I	Function II	Item	Function I	Function II
1	0.0476	0.0234	29	0.1291	0.0876
2	0.2288*	−0.1096	30	0.0107	−0.1047
3	0.0545	0.4515*	31	0.1459	−0.0273
4	0.5066*	0.1495*	32	0.2307*	0.1243
5	−0.0265	0.1971*	33	0.2725*	0.2026*
6	0.0884	0.1296	34	0.1923*	−0.0067
7	0.0033	0.0821	35	0.0142	−0.0551
8	0.1248	0.1247	36	−0.0753	−0.0417
9	0.1030	−0.1377	37	0.2619*	−0.1280
10	0.2618*	0.0935	38	−0.1462	0.1664*
11	−0.1475	0.1202	39	0.0139	0.1664*
12	0.1365	0.1367	40	0.3798*	−0.0550
13	0.1912*	−0.0089	41	−0.0368	0.2162*
14	−0.0060	−0.3210*	42	−0.0947	0.0714
15	−0.0310	−0.1059	43	0.2496*	−0.0658
16	−0.1690*	0.1348	44	0.1985*	0.2239
17	0.0741	0.1510*	45	0.1519*	−0.2109*
18	0.1672	0.0196	46	0.0026	−0.1226
19	0.0329	0.1422	47	0.2114*	−0.1544*
20	0.8417*	0.1018	48	0.1284	0.1918*
21	−0.0478	0.0706	49	0.1882*	0.4154*
22	0.2046*	−0.1947*	50	−0.0791	0.1165
23	0.0695	0.0627	51	−0.2124*	−0.0469
24	−0.0792	0.1315	52	0.2858*	0.1009
25	0.3179*	0.4148*	53	0.4460*	0.2879*
26	0.1044	0.0437	54	0.2397*	0.1526*
27	0.2072*	0.2565*	55	0.3993*	0.0874
28	−0.1506*	0.6524*			

*$r \geqslant 0.148$ is significant at the .01 level, N = 288.

Table 19. **Univariate F Tests for Guttman Items**
(dfb = 2; dfw = 285)

Item	F Ratio	p	Item	F Ratio	p
1	0.2635	0.7722	29	2.2329	0.1069
2	6.2864	0.0025	30	0.8076	0.5493
3	16.8475	0.0000*	31	2.1850	0.1122
4	33.1408	0.0000*	32	6.6555	0.0019
5	2.9441	0.0527	33	11.0867	0.0001*
6	2.0131	0.1333	34	3.7395	0.0242
7	0.4916	0.6180	35	0.2408	0.7892
8	2.7081	0.0665	36	0.6727	0.5158
9	2.4596	0.0852	37	8.4055	0.0005*
10	7.7833	0.0008*	38	4.2319	0.0152
11	3.2612	0.0385	39	0.8635	0.5741
12	3.2608	0.0386	40	16.0362	0.0000*
13	3.6992	0.0252	41	3.6079	0.0275
14	7.8819	0.0008*	42	1.2632	0.2837
15	0.9136	0.5953	43	6.7540	0.0018
16	4.2506	0.0149	44	7.9286	0.0007*
17	2.2288	0.1074	45	5.7176	0.0041
18	2.8383	0.0585	46	1.0986	0.3353
19	1.5901	0.2039	47	6.4019	0.0023
20	139.5116	0.0000*	48	4.4211	0.0128
21	0.5822	0.5646	49	18.0116	0.0000*
22	7.2185	0.0012	50	1.6184	0.1981
23	0.7649	0.5295	51	4.7555	0.0094
24	1.8963	0.1498	52	9.3584	0.0003*
25	26.6031	0.0000*	53	31.1972	0.0000*
26	1.2231	0.2954	54	7.7454	0.0008*
27	9.6032	0.0002*	55	18.3434	0.0000*
28	43.0700	0.0000*			

*Obviously significant at the .001 level.

Table 20. **Significance of Differences Between Pairs of Group Means On Selected Guttman Items**

Item	$\bar{X} - \bar{X}$ Ofs NCO (df = 188)	$\bar{X} - \bar{X}$ Ofs Amn (df = 196)	$\bar{X} - \bar{X}$ NCO Amn (df = 186)
3	5.8241*	2.0435	3.7582*
4	2.1153	5.6857*	7.9023*
10	1.1276	2.9854	3.6416*
14	3.8070*	1.9419	2.1428
20	1.7395	2.3724	5.7317*
25	5.3622*	1.5832	7.3496*
27	3.1160	1.0554	4.4534*
28	9.1704*	6.7205*	2.4562
33	2.2409	2.1538	4.2354*
37	1.6463	4.3734*	2.1812
40	0.0714	0.5449	4.1191*
44	2.8262	1.1143	3.9778*
49	5.6289*	0.1312	5.8817*
52	1.4266	2.8161	4.2042*
53	4.4444*	3.7518*	8.2111*
54	1.6063	2.5672	3.7009*
55	1.2838	4.4341*	5.3770*

*$p < .001$

Table 21. **Group Means for Guttman Items**

Item	Group: Officers (N=100)	Group: NCOs (N=90)	Group: Airmen (N=98)	Item	Group: Officers (N=100)	Group: NCOs (N=90)	Group: Airmen (N=98)
1	2.2300	2.2667	2.1735	29	3.8300	3.9778	3.6837
2	4.5900	4.4000	4.1020	30	4.6000	4.4444	4.5102
3	2.9400	4.0000	3.3163	31	3.7000	3.6556	3.4388
4	3.7700	4.1222	2.7551	32	4.0100	4.2111	3.7347
5	2.1700	2.6444	2.4592	33	3.8500	4.2556	3.5000
6	2.6300	2.8667	2.5816	34	3.6000	3.5889	3.2551
7	3.0200	3.2556	3.1224	35	4.1300	4.0222	4.0510
8	4.1600	4.3889	4.0408	36	4.8700	4.8333	4.9184
9	3.8200	3.6000	3.5510	37	4.5000	4.2333	3.8265
10	3.9600	4.1111	3.6122	38	2.2100	2.5222	2.6327
11	2.7100	2.9222	3.0714	39	3.7700	3.9333	3.8265
12	3.9800	4.1778	3.8776	40	4.8700	4.8000	4.3469
13	3.2100	3.1889	2.7245	41	3.0000	3.4111	3.2653
14	3.1100	2.4000	2.7857	42	3.0300	3.1889	3.3163
15	2.5300	2.3111	2.4898	43	4.1500	4.0556	3.7449
16	2.6000	2.8667	3.0612	44	3.5900	4.0111	3.4184
17	2.8100	2.0889	2.8061	45	4.2500	3.8444	3.7653
18	4.1300	4.1556	3.9286	46	4.4200	4.2111	4.3163
19	3.2000	3.4667	3.2653	47	4.1800	3.8778	3.6224
20	4.1800	4.4444	2.1633	48	3.2200	3.6222	3.1429
21	4.6400	4.7222	4.7347	49	2.5000	3.3556	2.5204
22	3.8200	3.4667	3.2755	50	3.8200	4.0556	4.0918
23	3.9400	4.0556	3.8673	51	2.0100	1.9333	2.3163
24	3.4999	3.6444	3.6633	52	4.4900	4.7000	4.0000
25	4.2100	4.6556	4.0816	53	4.0200	4.7000	3.2959
26	3.4800	3.5556	3.3367	54	1.5300	1.8111	1.2245
27	3.8100	4.2556	3.6633	55	4.4100	4.6000	3.6429
28	1.8700	3.3556	2.9184				

APPENDIX IX. DSCRIM AND RELATED STATISTICS FOR THE TWO DIFFERENTLY STRUCTURED SETS OF ITEMS

The DSCRIM between the structurally different sets of items is presented in Table 22a. Lambda for the discriminating power of the 55 items between the Likert and Guttman structures was 0.347 which had an associated probability of 0.000. In Table 22a, it can be seen that 100 percent of the trace was accounted for by one discriminant function. The centroids of these attitude scales computed relative to the function are reported in Table 22b. The correlations listed in Table 23 indicated the significant contributors to the separation between critique formats along the discriminant function. The univariate F tests reported in Table 24 and the scale means for all items tabulated in Table 25 revealed that the subjects had responded significantly differently to the content of 34 of the 55 items.

Table 22a. **Significance of the Discriminant Function χ^2 Approximation for the Between-Formats Analysis**

Percent of Trace	df	χ^2	p
100.00	55	577.797	0.000

Trace = 1.8785; λ = 0.347; F(55,519) = 17.726; p = 0.000

Table 22b. **Format Centroids in the Discriminant Space for the Likert and Guttman Data**

Format	Function
Likert	1.5340
Guttman	3.9424

Table 23. **Correlations Between Items of the Same Content From Both Critique Formats and the Discriminant Function**

Item	Correlation	Item	Correlation
1	−0.5470*	29	0.0460
2	0.3989*	30	0.4202*
3	0.2082*	31	0.2644*
4	0.2719*	32	0.2094*
5	−0.0356	33	0.1411*
6	0.0816	34	0.1794*
7	−0.0390	35	0.2218*
8	0.1294*	36	0.3640*
9	0.2091*	37	0.2790*
10	0.1421	38	0.2018*
11	0.1216*	39	0.4533*
12	0.2221*	40	0.2679*
13	−0.0346	41	−0.0544
14	−0.2810*	42	−0.2235*
15	−0.3179*	43	0.2445*
16	−0.3755*	44	0.0463
17	0.0319	45	0.2870*
18	0.2605*	46	0.5101*
19	−0.2420*	47	0.3543*
20	0.3587*	48	0.0308
21	0.4696*	49	0.0835
22	0.2578*	50	0.1371*
23	0.2199*	51	−0.6702*
24	0.1456*	52	0.2152*
25	0.0802	53	0.1655*
26	−0.1680*	54	−0.1682*
27	0.1188*	55	0.2024*
28	−0.1068		

*$r \geqslant .1150$ is significant at the .01 level, N = 575.

Table 24. **Univariate F Tests Between the Two Critique Formats for Each Item**

(dfb = 1: dfw = 573)

Item	F Ratio	p	Item	F Ratio	p
1	139.0406	0.0000*	29	0.7886	0.6215
2	66.3986	0.0000*	30	74.6090	0.0000*
3	16.6818	0.0002*	31	27.3977	0.0000*
4	29.0343	0.0000*	32	16.8794	0.0002*
5	0.4732	0.5010	33	7.5409	0.0063
6	2.5061	0.1098	34	12.2952	0.0008*
7	0.5672	0.5417	35	19.0163	0.0001*
8	6.3354	0.0117	36	54.2356	0.0000*
9	16.8260	0.0002*	37	30.6742	0.0000*
10	7.6571	0.0060	38	15.6391	0.0003*
11	5.5817	0.0175	39	88.7206	0.0000*
12	19.0533	0.0001*	40	28.1427	0.0000*
13	0.4460	0.5117	41	1.1108	0.2954
14	31.1331	0.0000*	42	19.3026	0.0001*
15	40.4517	0.0000*	43	23.2731	0.0000*
16	58.0746	0.0000*	44	0.8070	0.6273
17	0.3813	0.5445	45	32.5389	0.0000*
18	26.5561	0.0000*	46	117.1765	0.0000*
19	22.7758	0.0000*	47	51.1151	0.0000*
20	52.5224	0.0000*	48	0.3555	0.5585
21	96.3241	0.0000*	49	2.6183	0.1021
22	25.9899	0.0000*	50	7.1099	0.0078
23	18.6696	0.0001*	51	237.5800	0.0000*
24	8.0368	0.0050	52	17.8595	0.0001*
25	2.4042	0.1174	53	10.4258	0.0017
26	10.7539	0.0015*	54	10.7939	0.0015
27	5.3234	0.0202	55	15.7326	0.0002*
28	4.3001	0.0362			

*Obviously significant at the .001 level.

Table 25. **Item Means for Likert and Guttman Critique Formats**

Item	Format		Item	Format	
	Likert	Guttman		Likert	Guttman
1	3.2718	2.2222	29	3.7631	3.8264
2	3.6864	4.3646	30	3.9686	4.5208
3	2.9617	3.3993	31	3.1568	3.5972
4	2.9443	3.5347	32	3.6794	3.9792
5	2.4913	2.4167	33	3.6272	3.8576
6	2.5540	2.6875	34	3.1847	3.4792
7	3.2160	3.1285	35	3.7073	4.0694
8	3.9895	4.1910	36	4.4669	4.8750
9	3.3240	3.6597	37	3.6307	4.1875
10	3.6829	3.8889	38	2.1080	2.4514
11	2.6969	2.8993	39	3.1115	3.8403
12	3.7003	4.0069	40	4.3066	4.6701
13	3.1080	3.0382	41	3.3101	3.2188
14	3.3136	2.7778	42	3.5889	3.1771
15	3.0383	2.4479	43	3.6132	3.9826
16	3.4843	2.8403	44	3.5889	3.6632
17	2.8432	2.8958	45	3.4460	3.9583
18	3.7352	4.0694	46	3.3659	4.3194
19	3.6794	3.3056	47	3.2056	3.8958
20	2.7561	3.5764	48	3.2648	3.3194
21	4.1254	4.6979	49	2.6132	2.7743
22	3.0592	3.5278	50	3.7596	3.9861
23	3.5923	3.9514	51	3.3171	2.0903
24	3.3240	3.5660	52	3.9826	4.3889
25	4.2195	4.3056	53	3.6341	3.9861
26	3.7003	3.4549	54	1.8084	1.5139
27	3.7247	3.8993	55	3.7979	4.2083
28	2.9024	2.6910			

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13. ABSTRACT

This reported investigation is the Phase I effort of a task which undertakes to develop a new student critique form for Air Training Command (ATC). Specifically, it deals with the identification of valid and reliable psychometric measures of student attitudes toward Air Force technical training. Two critique form prototypes were developed using a Likert-type and a Guttman-type configuration. These were administered in a counterbalanced order to samples of officers, NCO, and airmen enrolled in an ATC technical school. Multiple-factor analyses and multiple discriminant function analyses were performed for the scored responses of the subjects to these critique forms. Test-retest reliability and factorial and discriminative validities were established for each of the prototypes. On the basis of the statistical analyses of the two forms, the Likert configuration was recommended for further development. Eight Likert factors, or unidimensional scales, were defined: Instructor Competence, Training Management, Specialty Training, Training Impressions, Training Facilities, Repetitious Instruction, Intelligible Media, and Textbook Utility. Because of demonstrated differences between rater groups, it was also recommended that group-specific forms be developed.

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